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NOTES ON THE LIFE HISTORY OF PRIONOCYPHON LIMBATUS LEC. (HELODIDÆ, COLEOPTERA)

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Early in the spring of 1922, while on a field trip to Ringwood Hollow, about eight miles from Ithaca, N. Y., many larvæ of a beetle were found in a pool close to the shore as well as on the bank. The adults of the beetle were unknown but were thought to belong to the family *Dasyllidæ*. The writer became interested in the larvæ and attempted to rear them in the laboratory. The larvæ were placed into a rectangular aquarium to which dirt and leaves from the pool were added at one end. The aquarium was then partially filled with water so that about half of the dirt was left exposed, above the surface of the water.

In their natural habitat, the larvæ live in still water, very near the shore, and then only where leaves are found on the surface. The larvæ are most abundant where the leaves are old and partially decomposed, for they feed on the broken-down epidermal cells of such leaves. This conclusion was reached after an examination of the skeletonized leaves and an examination of the stomach-contents of the larvæ. The larvæ also prefer the shadier places and are never found where the direct rays of the sun reach them. When a handful of the leaves is taken and the leaves separated, the exposed larvæ immediately seek shelter, traveling very quickly.

In order to know the habits of the larvæ better, several of them were placed in a glass jar and observations were made of

their activities in the water and on the leaves. They normally seek the underside of the leaves as much as possible and travel over them in a gliding manner. When jarred from the leaves or from any other object upon which they may be, they immediately rise to the surface of the water and crawl in an inverted position by means of their legs and elongate antennæ which serve as flagella. The last abdominal segment protrudes through the surface film and in this way they are able to breathe air directly by means of two spiracles situated on the last segment. There are also five fleshy protractile protuberances whose function the writer has not been able to determine. When hanging on the surface film, it is very difficult for the larvæ to descend to the bottom again unless there are leaves or other objects on which they can gain a foothold. This is due to the fact that they are supplied with very large tracheal tubes which, when filled with air, keep them afloat.

In the latter part of April and in the month of May many of the larvæ were found to be covered with an epiphytic, colonial protozoon, *Epistylus flavescens* Ehr. This thickly-clustered, tree-like organism gives the larvæ a whitish appearance, occurring on the dorsum of the larvæ and more usually towards the anterior end.

The rearing of the larvæ in the laboratory required very little attention except to provide them with sufficient water. On the fourteenth of May, many larvæ were found actively crawling around on the surface of the dry soil and excavating cells in the soil in which to pupate. On the fifteenth of May, one pupa was found. The pupal cell is spherical and a little larger than the pupa. The white pupæ may be easily recognized by the presence of four white, long, slender appendages on the prothorax. These very likely serve as spacers to keep the body from being covered with a body-film of water from the surrounding wet soil. They may also act as levers which enable the active pupæ to turn over, as they often do, especially when disturbed. On the twenty-third of May the first adult was found and from then on they were seen more often. An attempt was then made to find the pupæ in their natural environment. A considerable amount of soil was searched on the bank where the soil was drier, but no pupæ were to be found. A large log, partly submerged and covered with moss,

was then examined. This yielded satisfactory results. Five pupæ were found under the bark in cells which were made of chewed-up wood pulp. The cells were approximately three millimeters high and placed between the bark and the wood. Many larvæ were also found actively crawling through the soft, water-soaked wood. Unfortunately, there were no cells in the process of formation, so that the methods of construction could not be observed.

On the twenty-third of June, the last trip was taken to Ringwood Hollow to collect the adults. They were very scarce and only five were taken. The adults were found among leaves along the bank and in the shadier places, characteristic localities of the larvæ also. The adults are very active and, when disturbed, they attempt to hide under other leaves or they may take to flight. No adults could be found by beating the surrounding vegetation.

As to the complete life-history, there was insufficient time available to get the eggs. From the general habit of the larvæ and the adults, it is very likely that the adults lay their eggs under the leaves along the shore of the pools, in the late spring and early summer. They hibernate in the larval stage either in the second or third instar, depending upon whether there are four or five larval moults. There are two moults in the spring before pupation. Under natural conditions, the pupal stage lasts from ten to fourteen days, depending upon the temperature, while in the laboratory, the period was from seven to ten days.

DESCRIPTION OF THE STAGES OF PRIONOCYPHON LIMBATUS LEC.

Larva. Body subovate, widest at middle, broadly rounded in front and behind; lateral margins setose, 9-10 setæ on each abdominal segment, 8 on thoracic segments divided into 2 groups; color, dusky chestnut brown; length, 9-10 mm. Head-quadrangle, transverse, inserted into thorax to the eyes, rounded on sides, punctate; eyes large and conspicuous; long seta dorsad of eye; epicranial suture extending from eye to vertex, irregularly sinuate; antennæ inserted before eyes, very long, 100-150 segments; labrum quadrate, recurved on sides, strongly setose along cephalic border; epipharynx attached to the ventral surface, very compli-

cated (Fig. 6); mandibles strongly curved with their tips meeting, one long subapical seta, anterior margin with ten setæ, inner surface strongly grooved, densely hairy and punctate; maxillæ elongate, cardo subtriangular with basal angles rounded, stipes irregular with small tuft of setæ on outer edge, palpifer subquadrate, lacinia and galea rounded, hairy, palpus five-jointed, second joint setose; labium quadrate, lateral margin with 12 setæ, palpus 2-jointed, inserted on lateral anterior margin; hypopharynx inserted on labrum, very complicated (Fig. 7); antennæ very elongate, filiform, 100-150 segments, basal joint largest and setose, second joint with few apical setæ, following segments small and similar with two sensory pits on each, length 7-9 mm.

Thorax.—Quadrate, wider than head, lateral margin with 8 setæ in two groups on each segment; meso and metathorax two-thirds as long as prothorax, dorsal surface broadly rounded, sparsely and finely punctate. Legs lighter brown than body; coxæ transverse, elongate, separate; trochanter small, divided, sparsely setose; femora and tibiæ subequal, setose in regular rows; tarsi toothed, unisetose.

Abdomen.—Densely and finely setose, sub-ovate, tapering to apex, ninth segment four-lobed, bearing two spiracles and five retractile protuberances.

Tracheal System.—The larvæ are also easily characterized by having a very large tracheal system composed of two large air reservoirs leading from the anal spiracles. These two large sacs meet in the thorax and do not appear to give rise to any tracheæ in the abdominal regions. In the prothorax are found two small sacs which are connected to the main sac and which give rise to the tracheæ leading into the head. From the prothoracic portion of this main sac, there also arise two tracheæ which divide into smaller branches which lead to the prothorax. Behind each of the legs there is an additional small air-sac which supplies the legs. The tracheal system was observed by placing the larvæ, just after they had moulted and were lightly chitinized, into a solution of hæmotoxylin. The larvæ were very active at first but soon became quieter, when their internal structures could be observed. They will live several hours in this stain.

Circulatory System. The heart is also easily seen, extending from the penultimate abdominal segment to the thorax and the dorsal aorta extends to the middle of the prothorax. The ostia

also show very plainly. When the larvæ are motionless in the solution of hæmotoxylin, one can readily see the blood flow from the aorta into the head and from there to other transparent parts of the body. *The Brain* is composed of two fairly small lobes situated posteriorly in the head. The optic and antennal nerves can be traced very well, especially the latter. The subœsophageal and ventral ganglia could not be seen.

Pupa. White, turning brown before emergence. Body rugose and hairy. Head inserted deep into thorax to the eyes; eyes finely granulate; antennæ inserted between and before the eyes, 11-segmented, one-half length of body; labrum prominent, subquadrate, setose; labial palpi 4-jointed. Thorax with 4 long white tubercles, anterior pair the longer; medial discal impression present; mesothorax small, quadrate; methathorax transverse, finely punctate. Abdomen 9-segmented, tapering, finely punctate and hairy, 9th segment bearing two lobes.

DESCRIPTION OF THE ADULT

Body ovate, moderately convex, yellow-brown, elytra with large median dark spot, variable in size; front between the eyes with rounded dark band. Head retracted into thorax to the eyes, deflected; antennæ eleven-jointed, yellow, segments 4-11 fuscous; first segment subglobose, compressed, larger than the second and third united; labrum projected, transverse, prominent; terminal joint of maxillary palpus enlarged, triangular; labial palpi four-segmented, third arising from the side of the second; mandibles long, prominent. Thorax transverse, slightly narrowed in front, anterior margin sinuate; sides feebly rounded; surface finely and sparsely punctate, finely hairy; scutellum prominent, triangular. Prosternum prolonged between the front coxæ; coxæ separated, small, globose; trochanter distinct; femora wide, flattened; tibiæ slender, curved; metatarsus longer than the next two united; fourth joint deeply lobed, densely pubescent beneath, fifth joint small; middle coxæ contiguous, transverse, prominent; hind coxæ contiguous, large, grooved to receive the femora when in repose. Abdomen 5-segmented, equal in length, yellow, sparingly covered with fine hairs; elytra rather densely and finely punctate,

covered with silken hairs; epipleura wide at humeri extending to the apex. Length, 3.5-4.5 mm.

EXPLANATION OF PLATES VIII AND IX.

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| Fig. 1, Dorsal view of pupa..... | x17 |
| Fig. 2, Left fore-leg | x65 |
| Fig. 3, Adult, dorsal view..... | x17 |
| Fig. 4, Right mandible | x65 |
| Fig. 5, Left maxilla | x65 |
| Fig. 6, Labrum and epipharynx | x135 |
| Fig. 7, Labium and hypopharynx..... | x135 |
| Fig. 8, Base of antenna | x65 |
| Fig. 9, Larva, dorsal view..... | x25 |
| Fig. 10, Heart and brain. | |
| Fig. 11, Pupa, ventral view | x17 |
| Fig. 12. Respiratory system showing the trachea. | |